

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Mechanical Engineering



076

Study Programme	: Bachelor of Science Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	: DMX3304 Applied Electronics
Academic Year	: 2023/2024
Date	: 14 th February 2025
Time	: 09.30-12.30 hrs
Duration	: 3 hours

General Instructions

1. Read all instructions carefully before answering the questions.
 2. This question paper consists of **Eight (5)** questions on **Five (5)** pages.
 3. The answer for each question should commence from a new page.
 4. This is a Closed Book Test (CBT).
 5. Answers should be in clear handwriting.
 6. Answer to **all** questions.
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[Q1]

- a) Briefly explain the **Nodal Analysis** and the **Mesh Analysis** using relevant equations. [6 marks]
- b) Briefly explain the **Super Node**. [4 marks]
- c) Consider the circuit given in Figure Q1. Calculate the current through the 4Ω resistor by using Nodal analysis. [5 marks]
- d) A Low Pass Filter circuit consisting of a resistor of $4k7\Omega$ in series with a capacitor of $47nF$ is connected across a $10v$ sinusoidal supply. [5 marks]
 - i.) Draw and the equivalent circuit diagram.
 - ii.) Determine the output voltage (V_{out}) at a frequency of $100Hz$.

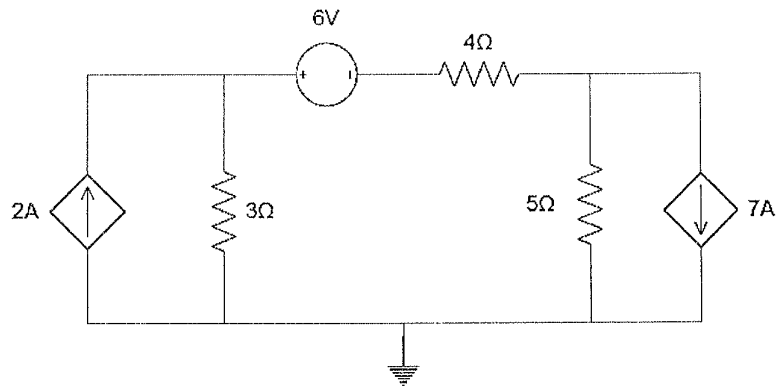


Fig. Q1

[Q2]

- Briefly explain how to use the Whiston Bridge circuit concept to find unknown resistance, state necessary equations and diagrams. [4 marks]
- The circuit shown in Figure Q2, consists of two resistors R_1 and R_2 with resistances.

$R_1 = 62\Omega$, $R_2 = 1.5\Omega$, one variable resistor R_{var} , one unknown resistor with value R_u , and a 9V battery connected. When R_{var} is adjusted to 122Ω , there is zero current through the Ammeter. Find the unknown resistance R_u . [10 marks]

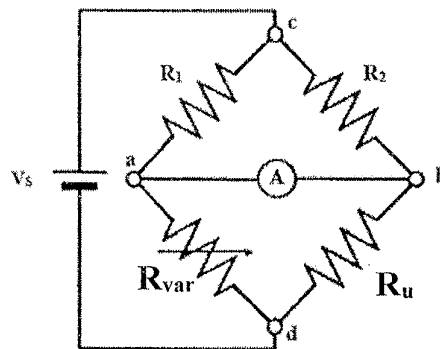


Fig. Q2

- In theory, any values can be used for R_1 and R_2 in the Wheatstone bridge of Figure Q2. For the bridge to balance, it is only the ratio R_1 / R_2 that is important. [6 marks]
 - What are practical problems might occur if the values are very small?
 - What are practical problems might occur if the values are very large?

[Q3]

- a) Sketch the output characteristics curve of a typical Bipolar Junction Transistor (BJT), and clearly show the operation regions. [4 marks]
- b) For the circuit shown in Figure Q3.1, find the following parameters. Assume $\beta = 100$. [6 marks]
- I_B and I_C
 - V_{CE}
 - V_B and V_C
 - Power dissipation in the transistor

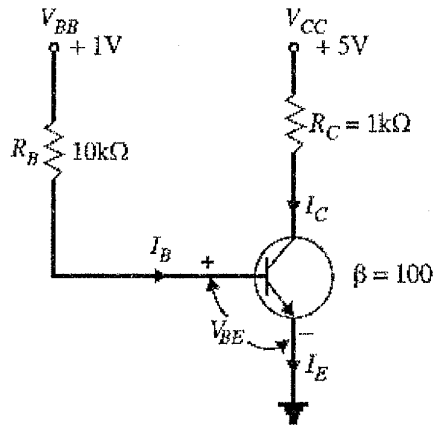


Fig. Q3.1

- c) What is the difference between Diode and Zener Diode? Sketch the V/I characteristic curves of both diodes. [4 marks]
- d) Consider the diode circuit shown in figure Q6(a). Find the diode current (I_D) by using each of the following methods. [6 marks]
- Ideal diode mode.
 - With 0.7V voltage barrier.

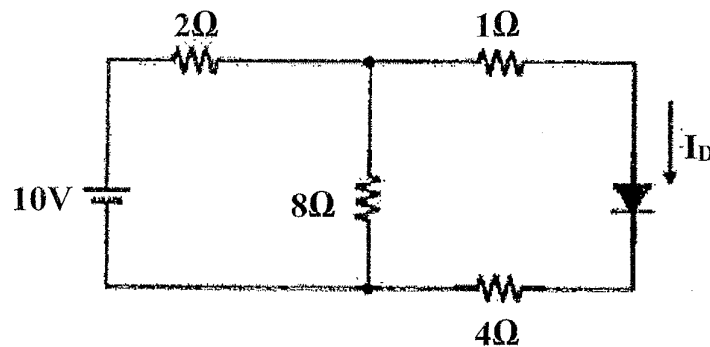


Fig. Q3.2

Q4

- Briefly explain four characteristics of an ideal operational amplifier (Op-Amp). [4 marks]
- Figure Q4.1 shows the circuit diagram of the non-inverting operational amplifier. based on the given notations, deduce the gain equation. [6 marks]

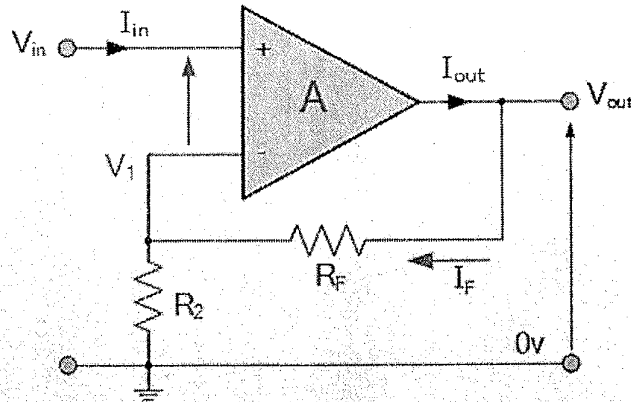


Fig. Q4.1

- Consider the Op-amp circuit shown in Figure Q4.2. If $V_i = 0.5V$. [10 marks]

Determine:

- The Output voltage V_o .
- The power dissipation of the $10k$ resistor.
- The gain of the amplifier.

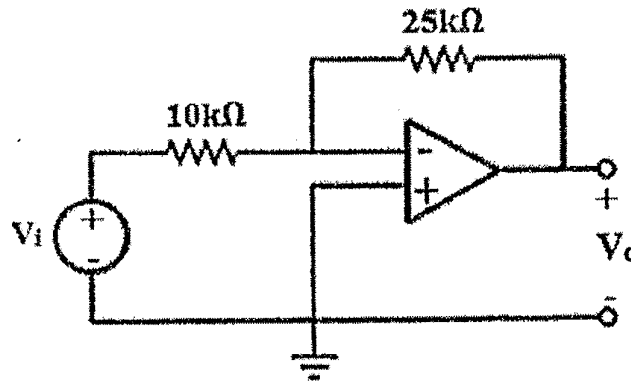


Fig. Q4.2

[Q5]

- a) Rewrite the following Boolean expression by using De-Morgan's theorem and implement the logic circuit using **NAND Gates** only. [4 marks]

$$Q = \overline{X + Y}$$

- b) Simplify the following Boolean function using K-map. [8 marks]

$$f(A, B, C) = \sum m(0, 2, 3, 5, 7)$$

- c) The K-map for a Boolean function is shown in Figure Q5.1, Find the number of essential prime implicants for this function. [4 marks]

		AB			
		00	01	11	10
CD	00	1	1	0	1
	01	0	0	0	1
	11	1	0	0	0
	10	1	0	0	1

Fig. Q5.1

- d) Draw the Logic diagram corresponding using basic logic gates for the following Boolean expression without simplifying. [4 marks]

$$(A + B)(C + D)(\bar{A} + B + D)$$

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